

**REMARKS/COMMENTS**

Claims 1-16 have been canceled. Claims 17-31 and new Claims 32-44 remain active in the case. Claims 17-25 stand withdrawn from consideration. Reconsideration is respectfully requested.

Applicants' representative wishes to thank Examiners Wright and Bos for the helpful and courteous discussion of December 9, 2003. As a result of the discussion it is believed that the issues in the case have been clarified and that the prosecution of the case has been materially advanced.

The present invention relates to a composite oxide powder which is useful as a catalyst support.

**CLAIM AMENDMENTS**

Claims 1-16 have been canceled in favor of new Claims 32-44. New Claim 32, in fact is a combination of original Claims 1, 5, 6, 8 and 15, and as such limits the amount of metal oxide M<sub>1</sub> (cerium oxide) to more than 50 % by wt. New Claim 44 is much the same as Claim 32 except that the amount of metal oxide M<sub>1</sub> (cerium oxide) is limited to at least 60 % by wt. Support for this limitation can be found in Example 18 of the application (paragraph [0139], pages 43 and 44). The new claims are fully supported by Claims 1-16 and are believed not to present new matter into the record of the present application. Entry of the new claims and amendments to Claims 26-31 is respectfully requested.

### INVENTION

The present invention is directed to a composite oxide powder which comprises particles of an oxide of metal  $M_1$  (Ce) and an oxide of metal  $M_2$  that is Al, Ti or Si, which does not dissolve in said oxide of metal  $M_1$ , wherein the cerium oxide constitutes more than 50 % by wt of the composite oxide powder. (In Claim 44 the amount of cerium oxide is at least 60 % by wt.) Further, the composite which results upon calcination of the composite powder has a porosity such that the pores in the size range of 3.5-100 nm in diameter have a volume of 0.07 cc/g or more attained at a calcination temperature of 600°C for 5 hours while the pores in the same size range of 3.5-100 nm in diameter have a volume of 0.04 cc/g or more attained at a calcination temperature of 800°C for 5 hours or more. The composite powder of the present invention results in a catalyst which exhibits excellent durability by suppressing noble metal grain growth during use of the catalyst at high temperature over long periods of time.

### PRIOR ART REJECTION - 35 U.S.C. § 103

Claims 1-16 and 26-31 stand rejected based on 35 U.S.C. § 103(a) as obvious over Brezny et al., U.S. Patent 6,528,451 or Suzuki et al., U.S. Patent 6,150,288 in view of Bouruetaubertot et al., U.S. Patent 5,397,758. This ground of rejection is respectfully traversed.

Brezny et al. represents prior art relevant to the present invention, because it discloses a composite oxide material useful as a catalyst support prepared from mixed cerium oxide and zirconium oxide. However, the required combination of cerium oxide and zirconium oxide in the preparation of the composite oxide is characterized by the fact that, as disclosed

at column 5, lines 43-49 of the reference, domains of the mixed oxide product consist predominantly of cerium oxide having zirconium oxide dissolved therein whereas other domains rich in zirconium oxide, consist predominantly of zirconium oxide having cerium oxide dissolved therein. This condition violates the limitation in present Claim 32 not only in that the oxide of metal  $M_2$  does not dissolve in the oxide of metal  $M_1$ , but zirconium oxide is not a metal oxide within the scope of the oxide of metal  $M_2$ . Moreover, in Brezny et al., there is no teaching or suggestion of the calcination characteristic of the present claims as such has an impact on the pore size range achieved at different calcination temperatures, ranging in the meso pore range of 3.5-100 nm.

As to Suzuki et al., the same discloses a composite oxide which is formed by mixing of solutions of salts of several elements at least one of which is cerium or zirconium and the other is aluminum. Upon mixing, precipitation and then firing of the material obtained, a composite oxide is formed. Although the combination of aluminum oxide/cerium oxide is a possibility of various mixed oxides within the scope of the Suzuki et al. disclosure (see column 3, line 30), there is no teaching or suggestion of the pore size range within the meso pore size range of 3.5-100 nm in diameter, as volume is influenced by the time and temperature of calcination conditions. Accordingly, Suzuki et al. neither shows nor suggests the composite powder of the present invention as claimed.

As noted in the discussion with the Examiner, the Bouruetaubertot et al. patent is pertinent to the present invention, because it discloses a composite oxide product, specifically mentioning a composite of cerium oxide and aluminum oxide. Further, the reference indicates a relationship between pore volume of pores of a certain size range and the thermal treatment to which the composite material is subjected. However, the present Claims are

clearly distinguished over the patent on the basis of the cerium oxide content of the composite oxide where the patent, at most, teaches a cerium oxide content of no more than 50 % by wt, preferably 15-40 % by wt (See column 2, lines 23-25 and Claim 6 of the patent), whereas, in the composite oxide as presently claimed, the content of cerium oxide is more than 50 % by wt of the composite oxide. (In new Claim 44, the distinction is clearer at the recitation of a cerium content of at least 60 % by wt.) Although, the patent speaks in terms of calcining a Ce/Al oxide product (Example 1) at different temperatures thereby providing a product whose pores are in the mesopore size range and in which pore diameter in relation to pore volume are specified, nevertheless, because the composite oxide of the present invention is materially different compositionally from the composite oxide of the reference, it can therefore be expected that if the two oxides are calcined under the same time and temperature conditions, that nonetheless products of different pore volume in relation to pore diameter, all for pores within the mesopore size range, are attained. Accordingly, the combination of references does not suggest the claimed composite oxide of the present invention, as well as the claimed catalyst embodiments of Claims 26-31, and therefore withdrawal of the rejection is respectfully requested.

Claims 1-16 and 26-31 stand rejected based on 35 U.S.C. § 103(a) as obvious over Rajaram et al., U.S. Patent 5,993,762 or Dettling et al., U.S. Patent 6,528,029 or Suda et al., U.S. Patent 6,391,276 each in view of Bouruetaubertot et al., U.S. Patent 5,397,758. This ground of rejection is respectfully traversed.

The Rajaram et al. patent discloses a composite oxide as a support for catalyst employed in the treatment of vehicle exhaust gases. As such, in an embodiment of the invention as disclosed in Example 6, the noble metals of palladium and platinum are

supported on a mixed oxide of cerium oxide and alumina. These mixed specific oxides are consistent with the disclosure of combinations of oxides in the reference at column 3, lines 10-23. However, there is no teaching or suggestion of specific calcination conditions as to temperature and time required to develop pores in the composite oxide product having a porosity such that the pores in the mesopore size range of 3.5-100 nm in diameter have a volume of 0.07 cc/g or more resulting from a calcination at 600°C for 5 hours and a volume of 0.04 cc/g or more at a calcination temperature of 800°C for 5 hours. Accordingly, the reference does not teach or suggest the composite oxide of the present invention, nor does it teach or suggest the catalyst resulting by the deposition of at least one noble metal on the composite oxide of the invention.

As to the Dettling et al. reference, the same describes a composite of at least two metal oxides which constitute what is identified as Primary Particles, which Primary Particles can then be supported on a conventional art known support material selected from the group of oxides and mixed oxides disclosed at column 6, lines 20-35 of the reference. The Primary Particles are identified as formed from rare earth oxides, alkaline earth metal oxides, transition metal oxides, zirconia, silica, alumina and titania at the top of column 4. In this broad disclosure there is no teaching or suggestion of the  $M_1/M_2$  oxide combination of the present invention. Moreover, although the reference teaches an alumina-ceria combination at column 6, line 27, this support, as the others, does not directly support a catalytically active metal such as Pt. Rather, the support oxides provide support for the Primary Particles. Note that Example 1 of the patent discloses the preparation of a Primary Particle, and here, the amount of cerium oxide in the four oxide component Primary Particle is only 28 %. Moreover, the mixed oxide does not contain the  $M_2$  component of the present mixed oxide.

Further, as to the alumina-ceria support material, there is no teaching anywhere in the reference that the alumina-ceria combination meets the conditions of the pore volume/calcination temperature relationship for mesopores of present Claim 32. Clearly such an oxide configuration does not describe the composite oxide powder of the present invention, nor does it describe the catalyst embodiments of the present invention resulting from the support of at least one noble metal on the present composite oxide.

The Suda et al. '276 reference is of comparative secondary importance, because it is directed to a titania/zirconia powder and a titania/zirconia/alumina powder which are said to have resistance against poisoning by acidic substances. However, there is no teaching or suggestion of the limitation of the present claims regarding the prohibition of the dissolvability of one metal oxide in another metal oxide. Further, there is no teaching or suggestion of the pore volume of pores within the specified mesopore size range of the present claims, as the pore volume is dependent upon the conditions of calcination of the mixed metal oxide.

Finally, the Bouruetaubertot et al. reference, which, in fact, discloses a cerium oxide/aluminum oxide combination containing no more than 50 wt % cerium oxide, is not improved upon by the prior art taken in combination with the reference, which art does not lead the skilled artisan specifically to a combination of cerium oxide with one or more of aluminum oxide, silicon oxide and titanium oxide, and certainly not to a specific combination of oxides which when calcined at specific temperatures gives a mesoporous product having the stated pore volume characteristics of the present invention. Accordingly, it is believed that the obviousness ground of rejection fails and withdrawal of the rejection as stated is respectfully requested.

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Claims 1-16 and 26-31 stand rejected based on 35 U.S.C. § 103(a) as obvious over Zhang et al., U.S. Patent 6,605,565 in view of Bouruetaubertot et al. '758. This ground of rejection is respectfully traversed.

The Zhang et al. reference is directed to the known area of cerium oxide/zirconium oxide technology as a catalyst support as indicated by the discussion on pages 1 and 2 of the present application. Although there is a teaching in column 3, lines 20 to 24 of the patent of the incorporation of an additional element in the oxide combination derived from silicon or aluminum, there is no teaching or suggestion of the composite oxide as claimed in the present invention of cerium oxide in combination with aluminum oxide, silicon oxide or titanium oxide, particularly with the requirement that the other oxide does not dissolve in the oxide of metal M<sub>2</sub>. Nor is there a teaching of the stated pore volume characteristics which are dependent upon the time and temperature conditions of a calcination treatment.

Finally, the Bouruetaubertot et al. reference does not improve upon the deficiencies of Zhang et al. That is, Zhang et al contains no disclosure which makes the disclosure of Bouruetaubertot et al any more relevant to the present claims. Accordingly, withdrawal of the outstanding ground of rejection is respectfully requested.

Restriction has been required in the present application between identified separate inventions of Claims 1-16 and 26-31 of Group I and Claims 17-25 of Group II. In order to comply with the requirement and to complete the written record of the case, Applicants hereby provisionally elect Claims 1-16 and 26-31 of Group I for examination with traverse.

Applicants traverse the rejection in part on the basis that it is clear that the Examiner would only have to consider two subclasses in order to complete a search of all of the claims in the case. Accordingly, the extent of such a search would not seem to impose an undue

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search burden upon the Examiner and therefore a complete search of relevant prior art for all of the claims is respectfully requested.

As to the reasons advanced why the indicated inventions are separate and distinct, the Examiner has not shown how the process embodiments of Claims 17-25 would result in a mixed oxide material other than the product of the present invention as claimed. Moreover, it has not been demonstrated that the product composite oxide of the invention can be produced by another and materially different process. Accordingly, it is believed that the Examiner has not met the burden placed on him to maintain the restriction requirement and withdrawal of the same is respectfully requested.

It is now believed that the application is in proper condition for allowance. Early notice to this effect is earnestly solicited.

Respectfully submitted,

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